LACK OF RECALL OF BIOSCIENCE KNOWLEDGE BY NURSING STUDENTS

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ABSTRACT

Ongoing knowledge of the human biosciences is necessary for good patient outcomes and high quality patient care by nurses. However, there are no studies that have determined the long-term (months/years) recall of bioscience knowledge by nursing students. The aims of the present study included determining the recall of bioscience by nursing students attending lectures for up to 16 months, and enabling students to reflect on their recall of bioscience knowledge. To measure recall, we used the MCQs from the first semester bioscience examination, and retested the students after four, nine and 16 months. We show that the initial knowledge of gastrointestinal physiology and introductory microbiology by nursing students was about 70% and 50%, respectively. After 16 months, there was a loss of recall of the gastrointestinal physiology, but not the microbiology knowledge and the recall was similarly low (~50%) for both topics. Approximately 77% of students who completed a questionnaire to evaluate testing of gastrointestinal physiology and 67% students who completed the microbiology testing considered that the MCQ testing was a useful learning exercise. Only half or less of the students considered they had enough recall to handle further gastrointestinal-related or microbiology lectures. Given this low level of measured and perceived recall, the nursing students may not have sufficient knowledge to undertake their subsequent pharmacology or nursing units. Among the students that attended lectures, this study suggests that initiatives to improve the recall of bioscience are necessary for nursing students.

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INTRODUCTION

Nursing students traditionally study the human biosciences (anatomy, physiology, pathophysiology and microbiology) in their first year at university. Knowledge of these human biosciences and, subsequently, pharmacology, is central to the development of competent nurses (Smales, 2010) with requisite knowledge and skills necessary for high quality patient care and good patient outcomes (Logan & Angel, 2011). Thus, it is necessary for the nursing students to recall their bioscience knowledge throughout their studies, and into their practice.

In the USA, students are required to have a basic knowledge of biology, anatomy and physiology to be accepted into nursing degree courses. Elsewhere this is not always the case, and it is well documented that nursing students struggle with bioscience and pharmacology in the UK and Australia (UK: reviewed in McVicar, Andrew and Kemble, 2015; McVicar, Clancy and Mayes, 2010; Australia: Davis, 2010; Whyte et al., 2010). In these countries, students find the bioscience and pharmacology components of the pre-qualifying curriculum, among the most difficult to learn. The reasons suggested for this include the poor science background of many students and the difficulties associated with a crowded curriculum. Research has consistently proposed that the difficulty, pre-qualifying students, have with bioscience leads to lower passing rates. Secondly, the course content is compromised so that students graduate with a school-level understanding of bioscience, which is probably inadequate to meet professional expectations (McVicar, Clancy and Mayes, 2010; Davis, 2010).

In order to be able to use their knowledge of bioscience in future studies and practice, nursing students, not only need to acquire this knowledge, but they also need to be able to recall it. A review of studies of science recall in medical education, reported up to a 33% loss of knowledge in the first year, which declined to 50-60% loss over the subsequent two years (Custers, 2010). No studies relating to nursing students were available to be included in this review by Custers (2010). Subsequently, there has only been one small study that showed no significant decrease in recall of chemistry by undergraduate nurses after 17 days delay between initial and follow-up testing (Bunce, VandenPlas and Soulis, 2011). Thus, there are no studies that have determined the long-term (months/years) recall of bioscience knowledge by nursing students.

The aims of the present study were (i) to determine the recall of bioscience by nursing students up to 16 months after initial testing, (ii) to determine whether telling the students that we were going to test their recall improved recall, and (iii) to give students the opportunity to reflect on their learning and understanding of biosciences.

METHODS

Discussions with the QUT Human Ethics Committee indicated that ethical review by the committee was not required for this project, provided students were not identifiable, and the study was conducted in accordance with the National Statement, which it was.

At QUT there are two campuses offering the Bachelor of Nursing degree; a city and a regional campus. Only the city campus has mid-year student intake. At each campus, four bioscience subjects (Bioscience 1, 2, 3 and Pharmacology) are offered progressively over four semesters. Bioscience 1 covers anatomy, physiology and introductory microbiology and Bioscience 2 and 3 cover pathophysiology and infectious diseases of the different body systems.

Students undertake an MCQ exam at the completion of Bioscience 1. In the following three semesters, in the successive bioscience subjects (four, nine and 16 months after the initial MCQ exam), we invited students who attended lectures to participate in the study. This invite occurred twice in each semester; firstly, testing recall of gastrointestinal physiology, and secondly, testing recall of introductory microbiology. Testing of gastrointestinal physiology occurred at the start of lectures on gastrointestinal pathophysiology four or nine months after the Bioscience exam, and at the start of the lectures on gastrointestinal pharmacology, 16 months post initial testing. Testing of introductory microbiology occurred in the lectures for gastrointestinal microbial diseases four or nine months post initial testing and in the lectures for pharmacology of anti-infectives, 16 months post initial testing.

The students, who agreed to participate, were given five MCQs from their final Bioscience 1 MCQ exam in either the gastrointestinal or microbiology topic to answer. The selection of MCQs was the same on each testing occasion and on both campuses. On the MCQ response form, students were asked to indicate their student number, but not their name and they were reassured that their names would not be identified in publication, that participation was entirely voluntary, and would not impact on their grades in any way.

The students were not given notice that their recall of gastrointestinal physiology was to be tested at the start of the lecture. In order to determine whether warning the students of the testing of introductory microbiology knowledge would improve their recall, students were given a warning during face-to-face lectures and via written notification on Blackboard, five days prior to the microbiology recall testing.

A week after the recall MCQs were completed, the students were invited to respond to the following survey statements using a 5-point Likert scale, with responses ranging from ‘strongly agree’ to ‘strongly disagree’, as follows (Figures 3): Doing this exercise…

1. Helped me focus for the class
2. Made me realise that I already had some knowledge of the topic
3. I think this was a useful learning experience
4. Made me realise I misunderstood aspects of the topic
5. Made me feel that I did not have enough background knowledge to handle the topic
6. Was distracting

Analysis of data

The participant’s results for the Bioscience exam (initial testing) and the MCQ recall testing were pooled according to the delay between the initial testing and recall testing of the MCQs. The participants tested at four, nine and 16 months after the exam were identified as cohorts 1, 2, and 3, respectively.

To determine whether there were any differences in the performance of the participants in the gastrointestinal physiology and introductory microbiology compared to the overall exam, the Bioscience 1 exam results for the five MCQs in these topics were compared to their overall exam. To determine the recall at four, nine and 16 months compared to the exam result, we compared the recall results for the five MCQs for each participant in the cohort with their results for the same MCQs in the

final Bioscience 1 MCQ. Mean percentage values were determined for each cohort. Individual values were compared by Students paired t-test. In addition, if the recall was significantly different for any of the cohorts, percentage difference in recall was determined for each participant, and compared between the cohorts by ANOVA.

RESULTS

Sample of students

The sample of students was drawn from those attending lectures on two campuses at QUT between 2012 and 2014. Student participation numbers ranged between 79 and 213 at testing. Up to 56% of participants were eliminated from the study due to incomplete MCQ response forms, changes to the Bioscience exam after 2012, and inadvertent participation by non-nursing (namely Paramedic) students and Advanced Standing students in the study.

Initial testing

The percentage overall mark for the students at the original Bioscience 1 exam was ~70% (Table 1). Cohort 1 did slightly, but significantly, better on the gastrointestinal questions than they did overall (Table 1). However, cohorts 2 and 3 originally performed similarly in the gastrointestinal questions as they did in the overall exam (Table 1).

Table 1: Exam results of nursing students in the different cohorts at initial testing

Gastrointestinal				**Microbiology**			
Exam	**Gastrointestinal MCQs in exam**		**P values**	**Exam**	**Microbiology MCQs in exam**		**P values**
74 ± 4.0 (17)	**cohort 1**	83 ± 4.3	0.043	73 ± 2.3 (66)	**cohort 1**	51 ± 3.6	P<0.0001
73 ± 1.2 (109)	**cohort 2**	72 ± 2.4	0.52	76 ± 1.2 (79)	**cohort 2**	61 ± 2.6	P<0.0001
67 ± 4.4 (14)	**cohort 3**	69 ± 6.3	0.76	72 ± 2.5 (24)	**cohort 3**	51 ± 4.5	P=0.0002
Each value is mean percentage ± SEM (n = number of students); cohort 1, 2, and 3 were tested 4, 9 and 16 months after the exam, respectively; p values from paired t-tests							

In contrast, the students from all three cohorts performed significantly less well on the microbiology questions than they did overall (Table 1).

Recall after four, nine and 16 months

The results show that over 16 months, there was a significant loss of knowledge recall for the gastrointestinal physiology (Figure 1), but not for microbiology (Figure 2).

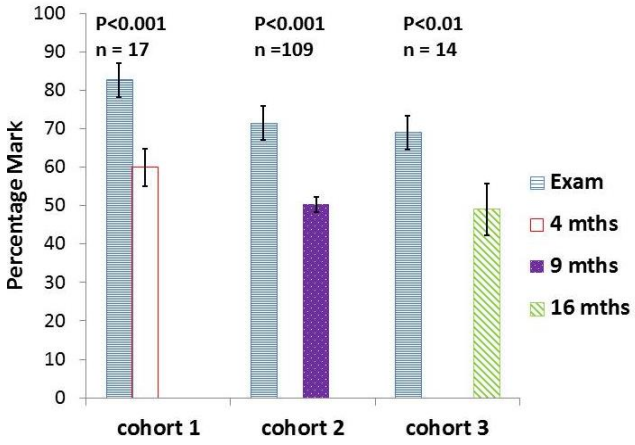

Figure 1. Gastrointestinal physiology recall testing.

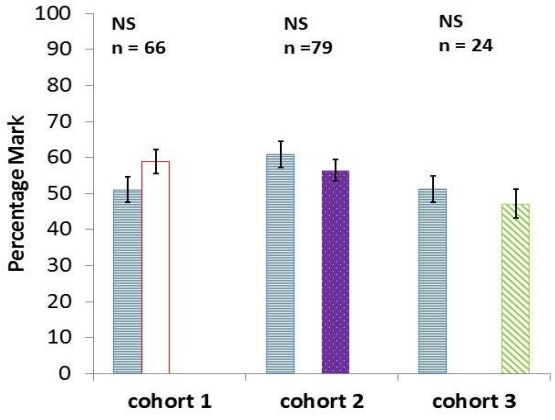

Figure 2. Microbiology recall testing.

For those cohorts in Figure 1, where there was a significant difference in recall, we calculated the percentage loss of recall. Thus, for the gastrointestinal physiology, there was a mean decrease in percentage recall of 18% ± SEM of 6.3 (n=17) after four months, 22% ± 3.7 (n=109) after nine months

and 33% ± 8.9 (n=14) after 16 months. These decreases were not significantly different between the cohorts (ANOVA: P = 0.47).

Although the results for initial testing of the gastrointestinal physiology and microbiology were different, after 16 months the recall was similarly low (~55%) for both the gastrointestinal and microbiology material.

Did prior notification about testing improve recall?
The students were not notified that their recall of the gastrointestinal material was going to be tested, and there was a decrease after four months, and the decrease remained similar at nine and 16 months. In contrast, notifying the students that their recall of the microbiology was going to be tested, was associated with no change in recall over time.

Evaluation of recall exercise by students
The results for the evaluation were similar after the gastrointestinal physiology and microbiology recall testing. Only the data for introductory microbiology is shown (Figure 3). About 60% of the students considered that the MCQs helped them focus for the class (Item 1 in Figure 3). Very few students disagreed with the statement "made me realise I had some knowledge of the topic" (Item 2). Approximately 77% of students that completed the gastrointestinal system testing and 67% students that completed the microbiology testing considered that the MCQ testing was a useful learning exercise (Item 3). More students reported they misunderstood aspects of the microbiology subject than the gastrointestinal physiology topic (Item 4; 51% vs 37%, P = 0.05). Only half or less of the students considered they had enough recall to handle further gastrointestinal or microbiology lectures (Item 5), and this was lower for microbiology than gastrointestinal physiology; (38% vs 54%, P = 0.04).

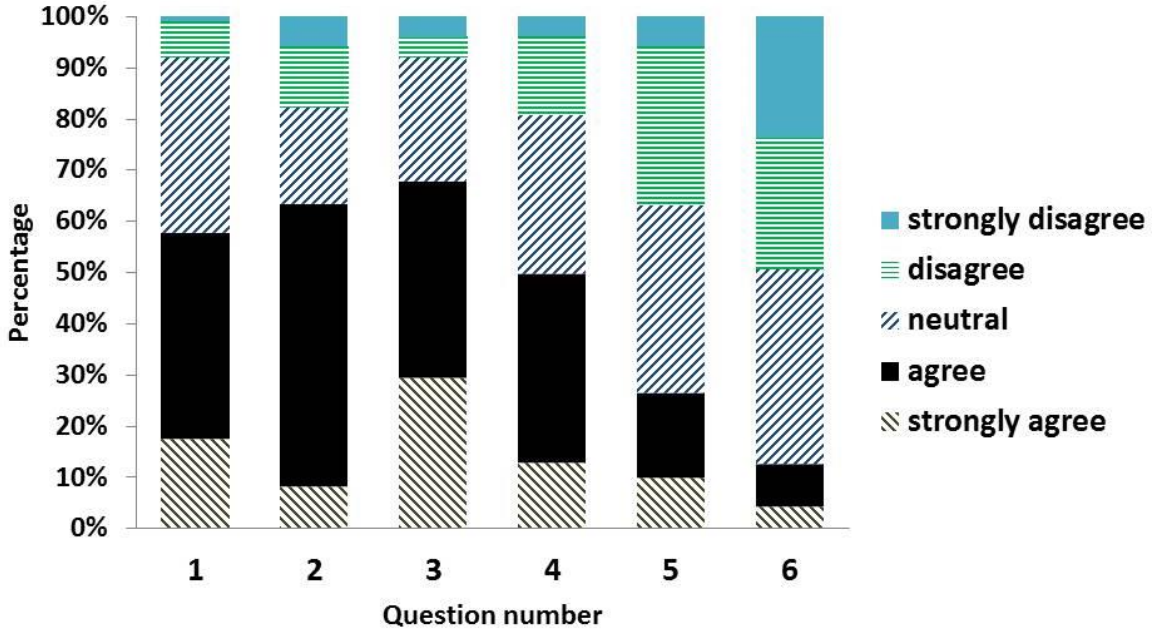

Figure 3. Survey results following MCQ recall testing of introductory microbiology

DISCUSSION

The findings from all three parts of this study suggest that initiatives to improve the recall of bioscience are necessary for nursing students. In the first part of the present study we determined the recall of bioscience by nursing students up to 16 months at the two campuses at QUT where nursing is taught. We report that knowledge of introductory microbiology was low at initial testing by the nursing students and there was not a loss of recall of introductory microbiology with time in our study. However we show a loss of recall of gastrointestinal physiology by the nursing students in our study. Although the loss of recall by the nursing students was lower than that previously reported in a review

by Custers (2010) for medical students, it would be premature to conclude that there is a difference in ability to recall by nursing and medical students on the basis of our single study with nursing students, compared to a review of many studies with medical students.

The second part of our study was to test whether warning the students, that we are going to test their recall, was beneficial. Thus, we warned the students that we were going to test their microbiology knowledge and subsequently this was associated with no measurable loss of microbiology recall. However, other factors (other than our warning) may have contributed to this recall of their microbiology, such as the ongoing teaching of microbiology in other topic areas. Thus, it will be necessary to test whether warning the students, that we are going to test their recall, works with other topics.

The third part of the study was a student questionnaire where the majority of students acknowledged the testing exercises were of benefit to their learning. Fewer than 30% of student participants considered they understood all aspects of their previous gastrointestinal and microbiology material. Additionally, less than half of the students considered they had enough recall to handle further gastrointestinal or microbiology lectures.

One unexpected finding was that the nursing students were weaker in microbiology than gastrointestinal material at initial testing. The reason for this was not determinable from our study. Despite the differing results at initial testing, the recall of gastrointestinal bioscience and microbiology by nursing students was similar after 16 months (~55%). With this low level of recall, the nursing students may not have sufficient knowledge recall to undertake their subsequent pharmacology or nursing units.

A limitation was that only students attending lectures were able to participate. Thus, the results of our study only directly apply to students who attend lectures. Any future research on this topic should probably be performed in a forum other than lectures due to the low attendance at lectures by the nursing students.

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